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According to the present invention, it is also possible to minimize low-frequency components such as a moiré pattern in a gradation image that is represented by outputted gradation image data.

Although a certain preferred embodiment of the present invention has been shown and described in detail, it should be understood that various changes and modifications may be made therein without departing from the scope of the appended claims.

IN THE CLAIMS:

Please enter the following amended claims:

What is claimed is:

A2

1. (Amended) A method of determining a threshold arrangement for generating a gradation image to determine a position of at least one threshold of the same value for a next gradation when positions of thresholds ranging from a smaller threshold to a threshold for a given gradation are determined in a threshold arrangement, comprising the steps of:

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(A) determining at least one candidate position for the position of at least one threshold of the same value for the next gradation; and

(B) determining the position of the threshold for the next gradation from said candidate position ,

said step (B) comprising the steps of:

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extracting a low-frequency component from image data obtained based on the threshold arrangement in which the positions of the thresholds ranging to said threshold for the given gradation are determined (1st step;)

A2

determining a low-frequency component intensity at said at least one candidate position (2nd step;

determining the candidate position where the determined low-frequency component intensity is weakest as the position of the threshold for the next gradation (3rd step; and

repeating said step of extracting a low-frequency component, said step of determining a low-frequency component intensity, and said step of determining the candidate position until all positions of at least one threshold of the same value for the next gradation are determined.

3. (Amended)A method according to claim 1, wherein said step of extracting a low-frequency component comprises the step of:

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weighting a low-frequency component according to human visual characteristics and extracting the weighted low-frequency component.

4. (Amended)A method of determining a threshold arrangement for generating a gradation image to determine a position of at least one threshold of the same value for a next gradation when positions of thresholds ranging from a greater threshold to a threshold for a given gradation are determined in a threshold arrangement, comprising the steps of:

(A)determining at least one candidate position for the position of at least one threshold of the same value for the next gradation; and

(B)determining the position of the threshold for the next gradation from said candidate position,

said step (B) comprising the steps of:

extracting a low-frequency component from image data obtained based on the threshold arrangement in which the positions of the thresholds ranging to said threshold for the given gradation are determined (1st step);

determining a low-frequency component intensity at said at least one candidate position (2nd step);

A3

determining the candidate position where the determined low-frequency component intensity is strongest as the position of the threshold for the next gradation (3rd step); and

repeating said step of converting image data, said step of determining a low-frequency component intensity, and said step of determining the candidate position until all positions of at least one threshold of the same value for the next gradation are determined.

5. (Amended)A method according to claim 4, wherein said threshold arrangement comprises a threshold arrangement for generating a halftone dot gradation image.

6. (Amended) A method according to claim 4, wherein said step of extracting a low-frequency component comprises the step of:

weighting a low-frequency component according to human visual characteristics and extracting the weighted low- frequency component.

7. (Amended)A method of determining a threshold arrangement for generating a gradation image to determine a position of at least one threshold for a next gradation when

positions of thresholds ranging from a smaller threshold to a threshold for a given gradation are determined in a threshold arrangement, comprising the steps of:

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extracting a low-frequency component from image data obtained based on the threshold arrangement in which the positions of the thresholds ranging to said threshold for the given gradation are determined (1st step); and determining the position where the intensity of the extracted low-frequency component is weakest as the position of the threshold for the next gradation (2nd step).

9. (Amended) A method according to claim 7, wherein said step of extracting a low-frequency component comprises the step of:

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weighting a low-frequency component according to human visual characteristics and extracting the weighted low-frequency component.

10. (Amended)A method of determining a threshold arrangement for generating a gradation image to determine a position of at least one threshold for a next gradation when positions of thresholds ranging from a greater threshold to a threshold for a given gradation are determined in a threshold arrangement, comprising the steps of:

extracting a low-frequency component from image data obtained based on the threshold arrangement in which the positions of the thresholds ranging to said threshold for the given gradation are determined (1st step); and determining the position where the intensity of the extracted low-frequency component is strongest as the position of the threshold for the next gradation (2nd step).

11. (Amended)A method according to claim 10, wherein said threshold arrangement comprises a dither matrix.

12. (Amended)A method according to claim 10, wherein said step of extracting a low-

A4 frequency component comprises the step of:

weighting a low-frequency component according to human visual characteristics and extracting the weighted low- frequency component.

13.(Amended)An apparatus for generating gradation image data, comprising:

a recording medium for storing a plurality of threshold arrangements for generating gradation image data;

selecting means for selecting a threshold arrangement from the threshold arrangements stored in said recording medium; and

gradation image data generating means for generating gradation image data using the threshold arrangement selected by said selecting means;

wherein each of the threshold arrangements stored in said recording medium comprises such a threshold arrangement

that a low-frequency component is extracted from gradation image data generated by said gradation image data generating means based on a threshold arrangement ranging from a smaller threshold to a threshold for a given gradation, and

thereafter the position of a threshold for a gradation next to said given gradation is a position where a low-frequency component is weakest among the extracted low-frequency component.

14. (Amended)An apparatus for generating gradation image data, comprising:

a recording medium for storing a plurality of threshold arrangements for generating gradation image data;

selecting means for selecting a threshold arrangement from the threshold arrangements stored in said recording medium; and

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gradation image data generating means for generating gradation image data using the threshold arrangement selected by said selecting means;

wherein each of the threshold arrangements stored in said recording medium comprises such a threshold arrangement that a low-frequency component is extracted from gradation image data generated by said gradation image data generating means based on a threshold arrangement ranging from a greater threshold to a threshold for a given gradation, and thereafter the position of a threshold for a gradation next to said given gradation is a position where a low-frequency component is strongest among the extracted low-frequency component.

15. (Amended)A method of determining a threshold arrangement for generating a gradation image to determine positions of thresholds for gradations higher and lower than a given gradation when a dot pattern for the given gradation are is determined , comprising the steps of:

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determining positions of thresholds for higher gradations; and

determining positions of thresholds for lower gradations,

said step of determining positions of thresholds for higher gradations comprising the steps of:

(Aa) determining at least one candidate position for the position of at least one threshold (Th, having Tfix + 1 as an initial value) of the same value for the next gradation higher than the given gradation;

(Ba) determining the position of the threshold (Th) for the next gradation from said candidate position;

(Ca) updating the threshold (Th) with an increment thereof by 1 (Th + 1 → Th) and

repeating said steps (Aa), (Ba), and (Ca) until all positions of the thresholds for gradations higher than the given gradation are determined,

said step (Ba) comprising the steps of:

(Ba1) extracting a low-frequency component from image data obtained based on the threshold arrangement in which the positions of the threshold (Th .1) for the gradation are determined;

(Ba2) determining a low-frequency component intensity at said at least one candidate position;

(Ba3) determining the candidate position where the determined low-frequency component intensity is weakest as the position of the threshold (Th) for the next gradation; and

repeating said steps (Ba1), (Ba2), and (Ba3) until all positions of said at least one threshold (Th) of the same value for the next gradation are determined,

said step of determining positions of thresholds for lower gradations comprising the steps of:

(Ab) determining at least one candidate position for the position of at least one threshold (Tl, having Tfix 1 as an initial value) of the same value for the next gradation lower than the given gradation;

(Bb) determining the position of the threshold (Tl) for the next gradation from said candidate position;

(Cb) updating the threshold (Tl) with a decrement thereof by 1 (Tl - 1 → Tl) and repeating said steps (Ab), (Bb), and (Cb) until all positions of the thresholds for gradations lower than the

given gradation are determined,

said step (Bb) comprising the steps of:

(Bbl) extracting a low-frequency component from image data obtained based on the threshold arrangement in which the positions of the threshold (Tl + 1) for the gradation are determined;

(Bb2) determining a low-frequency component intensity at said at least one candidate position;

(Bb3) determining the candidate position where the determined low-frequency component intensity is strongest as the position of the threshold (Tl) for the next gradation; and

repeating said steps (Bbl), (Bb2), and (Bb3) until all positions of said at least one threshold (Tl) of the same value for the next gradation are determined.

16. (Amended)A method according to claim 15, wherein said threshold arrangement comprises a threshold arrangement for generating a halftone dot gradation image.

17. (Amended)A method according to claim 15, wherein said step (Bal) comprises the step of:

weighting a low-frequency component according to human visual characteristics and extracting the weighted low-frequency component.

A4

18. (Amended)A method of determining a threshold arrangement for

generating a gradation image to determine positions of thresholds for gradations between two given gradations when two dot patterns for the two given gradations are respectively determined , comprising the steps of:

(Ac) determining at least one candidate position for the

position of at least one first threshold (Th, having

Tfixl + 1 as an initial value) of the same value for the next gradation higher than one of the given gradations having the smaller threshold (Tfixl);

(Bc) determining the position of the first threshold (Th) for the next gradation from said candidate position determined in the step (Ac);

(Ad) determining at least one candidate position for the position of at least one second threshold (Tl, having Tfix2 .1 as an initial value) of the same value for the next gradation lower than the other of the given gradations having the greater threshold (Tfix2);

(Bd) determining the position of the second threshold (Tl) for the next gradation from said candidate position determined in the step (Ad);

(Cc) updating the first and second thresholds (Th and Tl) with an increment of the first threshold (Th) by 1

(Th + 1 → Th) and a decrement of the second threshold (Tl) by 1 (Tl - 1 → Tl) and

repeating said steps (Ac), (Bc), (Ad), and (Bd) until all positions of the thresholds between the thresholds

(Tfix1 and Tfix2) for the given different gradations are determined,

said step (Bc) comprising the steps of:

44 (Bc1) extracting a low-frequency component from image data obtained based on the threshold arrangement in which the positions of the first threshold (Th .1) for the gradation

are determined;

(Bc2) determining a low-frequency component intensity at said at least one candidate position; and

(Bc3) determining the candidate position where the determined low-frequency component intensity is weakest as the position of the first threshold (Th) for the next gradation,

said step (Bd) comprising the steps of:

(Bd1) extracting a low-frequency component from image data obtained based on the threshold arrangement in which the positions of the second threshold (Tl + 1) for the gradation are determined;

(Bd2) determining a low-frequency component intensity at said at least one candidate position; and

(Bd3) determining the candidate position where the determined low-frequency component intensity is strongest as the

position of the second threshold (Tl) for the next gradation.

19. (Amended)A method according to claim 18, wherein said threshold arrangement

A4 comprises a threshold arrangement for generating a halftone dot gradation image.

20. (Amended)A method according to claim 18, wherein said step (Bc-1) of extracting a low-frequency component comprises the step of:

weighting a low-frequency component according to human visual characteristics and extracting the weighted low-frequency component.

Claims 21 - 28 are added as mew claims.

21. A method according to claim 19, wherein said step (Bcl) of extracting a low-frequency component comprises the step of:

A5 weighting a low-frequency component according to human visual characteristics and extracting the weighted low-frequency component.

22. A method of determining a threshold arrangement for generating a gradation image to determine positions of thresholds for gradations higher and lower than a given gradation when a dot pattern for the given gradation is determined in the threshold arrangement, comprising the steps of:

determining positions of thresholds for higher gradations; and

determining positions of thresholds for lower gradations,

said step of determining positions of thresholds for higher gradations comprising the steps of:

(1) converting image data obtained based on the threshold arrangement in which the positions of the threshold (Th - 1) for the gradation are determined into data in a frequency space and extracting a low-frequency component from the data;

(2) determining a position where the low-frequency component intensity is weakest as the position of the threshold (Th) for the next higher gradation; and

(3) updating the threshold (Th) with an increment thereof by 1 (Th + 1 → Th) and

repeating said steps (1), (2), and (3) until all positions of the thresholds for gradations higher than the given gradation are determined,

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said step of determining positions of thresholds for lower gradations comprising the steps of:

(4) converting image data obtained based on the threshold arrangement in which the positions of the threshold (Tl + 1) for the gradation are determined into data in a frequency space and extracting a low-frequency component from the data;

(5) determining a position where the low-frequency component intensity is strongest as the position of the threshold (Tl) for the next lower gradation; and

(6) updating the threshold (Tl) with a decrement thereof by 1 (Tl - 1 → Tl) and

repeating said steps (4), (5), and (6) until all positions of the thresholds for gradations lower than the given gradation are determined.

23. A method according to claim 22, wherein said threshold arrangement comprises a dither matrix.

24. A method according to claim 22, wherein said step (1) of extracting a low-frequency component comprises the step of:

weighting a low-frequency component according to human visual characteristics and extracting the weighted

low-frequency component.

25. A method of determining a threshold arrangement for generating a gradation image to determine positions of thresholds for gradations between two given gradations when two dot patterns for the given gradations are respectively determined , comprising the steps of:

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(1) converting image data obtained based on the threshold arrangement in which the positions of the threshold (Tfixl = Th - 1) for the given gradation are determined into data in a frequency space and extracting a low-frequency component from the data;

(2) determining a position where the low-frequency component intensity is weakest as the position of a first threshold (Th) for the next higher gradation;

(3) converting image data obtained based on the threshold arrangement in which the positions of the threshold (Tfix2 = Tl + 1) for the given gradation are determined into data in a frequency space and extracting a low-frequency component from the data;

(4) determining a position where the low-frequency component intensity is strongest as the position of a second threshold (Tl) for the next lower gradation;

(5) updating the first and second thresholds (Th and Tl)with an increment of first threshold (Th) by 1 (Th + 1 → Th)and a decrement of second threshold (Tl) by 1 (Tl - 1 → Tl); and

repeating said steps (1), (2), (3), (4), and (5) until all positions of the thresholds between the thresholds(Tfixl and Tfix2) for the given different gradations are determined.

26. A method according to claim 25, wherein said threshold arrangement comprises a dither matrix.

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27. A method according to claim 25, wherein said step

(1) of extracting a low-frequency component comprises the step of:

weighting a low-frequency component according to human visual characteristics and extracting the weighted low-frequency component.

28. A method according to claim 26, wherein said step

(1) of extracting a low-frequency component comprises the step of:

weighting a low-frequency component according to human visual characteristics and extracting the weighted low-frequency component.